CLAIMS

What is claimed is:

1. Optical apparatus, comprising:

a constant wave (CW) laser source;

a digitally modulated pump laser source; and

a first cross-junction waveguide optical switch having a first optical input for receiving light from the CW laser source, a second optical input for receiving the first optical input pump signal, a first optical output for outputting a digital copy of the first optical input pump signal, and a second optical output for outputting an inverted copy of the first optical input pump signal, and wherein the first optical input CW signal is controllably directed to the first or second optical outputs as a result of total internal reflection within the optical switch that is optically induced by the digitally modulated light output by the pump laser source.

2. The apparatus recited in Claim 1 further comprising:

a second cross-junction waveguide optical switch having a first optical input for receiving the non-inverted output signal from the first optical switch, a second input for receiving a second digitally modulated optical input pump signal, a first optical output for outputting the digital product of the second optical input pump signal and the non-inverted output from the first optical switch, and a second optical output for outputting an inverted digital product of the second optical input pump signal and the non-inverted output from the first optical switch.

3. The apparatus recited in Claim 2 wherein the non-inverted output from the second optical switch is a digital product of the first and second digital input pump signals and implements a two-input AND gate function.

4. The apparatus recited in Claim 2 wherein the inverted output product from the second optical switch implements a two-input NAND gate function.

5. The apparatus recited in Claim 2 further comprising:

a third optical switch having a first optical input for receiving the non-inverted output signal from the second optical switch, a second input for receiving a third digitally modulated optical input pump signal, a first optical output for outputting the digital product of the third optical input pump signal and the non-inverted output signal from the second optical switch, and a second optical output for outputting an inverted digital product of the third optical input pump signal and the non-inverted output signal from the second optical switch.

6. The apparatus recited in Claim 5 wherein the non-inverted output from the third optical switch is a digital product of the first, second and third digital input pump signals and implements a three-input AND gate function.

7. The apparatus recited in Claim 5 wherein the inverted output product from the third optical switch implements a three-input NAND gate function.

8. Optical apparatus for implementing an S-R latch function, comprising:

a first CW laser source;

a first optical switch having a first optical input for receiving light from the first CW laser source, a second optical input for receiving a first digitally modulated optical input pump signal (S), a first optical output for outputting a digital copy of the first optical input pump signal, and a second optical output for outputting an inverted copy of the first optical input pump signal;

a second optical switch having a first optical input for receiving the non-inverted output signal from the first optical switch, a second input for receiving a second digitally modulated optical input pump signal ($\overline{Q}$), a first optical output for outputting the digital product of the second optical input pump signal and the non-inverted output signal from the first optical switch, and a second optical output (Q) for outputting an inverted digital product of the second optical input pump signal and the non-inverted output signal from the first optical switch;

a second CW laser source;

a third optical switch having a first optical input for receiving light from the second CW laser source, a second optical input for receiving a second digitally modulated optical input pump signal (R), a first optical output for outputting a digital copy of the second optical input pump signal, and a second optical output for outputting an inverted copy of the second optical input pump signal; and

a fourth optical switch having a first optical input for receiving the non-inverted output signal from the third optical switch, a second input for receiving a second digitally modulated optical input pump signal (Q), a first optical output for outputting the digital product of the second optical input pump signal and the non-inverted output signal from the third optical switch, and a second optical output ($\overline{Q}$) for outputting an inverted digital product of the second optical input pump signal and the non-inverted output signal from the third optical switch; and

wherein the inverted second optical output signal ($\overline{Q}$) of the fourth optical switch is input to the second input of the second optical switch, and the inverted second optical output signal (Q) of the second optical switch is input to the second input of the fourth optical switch.

9. An optical binary memory cell comprising:

(1) a first optical switch having a first optical input for receiving light from a first CW laser source, a second optical input for receiving a digitally modulated optical DATA INPUT pump signal, a first optical output for outputting a digital copy of the optical DATA INPUT pump signal, and a second optical output for outputting an inverted copy of the optical DATA INPUT pump signal;

(2) a second optical switch having a first optical input for receiving light from a second CW laser source, a second optical input for receiving a digitally modulated optical READ/WRITE input pump signal, a first optical output for outputting a digital copy of the optical READ/WRITE input pump signal, and a second optical output for outputting an inverted copy of the optical READ/WRITE input pump signal;

(3) first and second three-input optical AND gates that each comprise:

a third optical switch having a first optical input for receiving light from a CW laser source, a second optical input for respectively receiving the non-inverted and inverted optical output signals from the first optical switch, a first optical output for outputting a digital copy of the second optical input signal to the third optical switch, and a second optical output for outputting an inverted copy of the second optical input signal to the third optical switch;

a fourth optical switch having a first optical input for receiving the non-inverted optical signal output by the first optical switch, a second input for receiving the inverted optical output signal from the second optical switch, a first optical output for outputting a digital product of the optical input signals to the fourth optical switch, and a second optical output for outputting an inverted product of the optical input signals to the fourth optical switch; and

a fifth optical switch having a first optical input for receiving the non-inverted optical data output signal from the second optical switch, a second input for receiving a digitally modulated SELECT optical input pump signal, a first optical output for outputting a digital product of the optical input signals to the fifth optical switch, and a second optical output for outputting an inverted product of the optical input signals to the fifth optical switch, and wherein the non-inverted output from the fifth optical switch comprises the output of the three-input optical AND gate;

(4) first and second two-port optical NAND gates that each comprise:

a sixth optical switch having a first optical input for receiving light from a CW laser source, a second optical input for receiving the non-inverted optical signal output by the respective first and second three-input optical AND gates, a first optical output for outputting a digital copy of the second optical input signal to the first optical switch,

and a second optical output for outputting an inverted copy of the second optical input signal to the sixth optical switch; and

a seventh optical switch having a first optical input for receiving the non-inverted optical signal outputted by the respective sixth optical switch, a second input for receiving a second optical input signal comprising an output signal from the opposing NAND gate, a first optical output for outputting a digital product of the optical input signals to the seventh optical switch, and a second optical output for outputting an inverted product of the optical input signals to the seventh optical switch;

wherein the output of the first two-port optical NAND gate comprises the second optical output of the second optical switch, and the output of the second two-port optical NAND gate comprises the first optical output of the second optical switch; and

(5) a third three-input optical AND gate that comprises:

an eighth optical switch having a first optical input for receiving light from a CW laser source, a second optical input for receiving the optical output signal from the first two-port optical NAND gate, a first optical output for outputting a digital copy of the second optical input signal to the eighth optical switch, and a second optical output for outputting an inverted copy of the second optical input signal to the eighth optical switch;

a ninth optical switch having a first optical input for receiving the non-inverted optical output signal from the first switch, a second input for receiving the non-inverted optical output signal from the second optical switch, a first optical output for outputting a digital product of the optical input signals to the ninth optical switch, and a second optical output for outputting an inverted product of the optical input signals to the ninth optical switch; and

a tenth optical switch having a first optical input for receiving the non-inverted optical output signal from the second optical switch, a second input for receiving a digitally modulated SELECT optical input pump signal, a first optical output for outputting a digital product of the optical input signals to the tenth optical switch, and a second optical output for outputting an inverted product of the optical input signals to the tenth optical switch, and which implements a three-input AND gate function that outputs an optical data output signal from the memory cell.